flight. The only question was whether the velocity impressed by the electric action could be made relatively sufficiently great. This depended upon the magnitude of the electric density at the surface of the electrified body, and for this reason Righi used a very sharp point for the discharge. Fig. 1 shows the arrangements for obtaining the electric shadows by Righi's process. A B is an ordinary retort-stand of iron, and upon it are clamped three adjustable arms of ebonite. The uppermost of these carries a short metal rod, pointed below and terminated above in a metal ball. The intermediate support carries the object, C, which is to cast the shadow. The lowermost arm is fashioned as a clip in which can be held a disk, D, to receive the shadows. This disk is preferably of ebonite backed on its under side with brass or tinfoil. In certain cases a metal disk varnished on the upper surface is used. Fig. 2 shows a favourite form of object for casting a shadow—a floral or cruciform design cut from thin metal and mounted on a stem of ebonite or glass. To produce the shadow-figures a Leyden jar is charged to such a potential as to be able to yield a spark of 1 to 2 centimetres' length. The outer coating is put in communication with the lower surface of the disk D, and the knob of the jar communicating with its inner coating is then brought into contact with the top of the pointed rod. The jar discharges itself rapidly and almost noiselessly. Then there is immediately sifted over the disk, from a box covered with muslin, some mixed powders of minium and flowers of sulphur, in the usual manner of procuring Lichtenberg's figures. A shadow of the interposed object is at once revealed by the powders. If the discharge has been a positive one, the shadow of the cross will appear in red surrounded by a neutral region, outside which there will be a region tinted yellow with sulphur. The colours will be reversed with a negative discharge. The shadow is depicted in Fig. 3. The size of the shadow varies with the distance of the object. Righi recommends that the object should be three centimetres above the disk, and the point twelve centimetres, or less, above the object. The lines of discharge appear to be hyperbolic in form. If a disk of ebonite only be placed at D, and the brass disk below it be lowered down, the effects are less distinct. If a narrow strip of foil or thin brass be placed below the ebonite disk, the shadow becomes compressed laterally and shows itself only on the region over the strip, and takes the form shown in Fig. 4. Similar shadows can be obtained according to Righi, on metallic disks covered with non-conducting varnish, but in this case by the use, not of the Leyden jar, but of an influence machine. This method is identical with one of Holtz's suggestion. Righi also finds that if the metal disk be previously coated with a conducting powder, such as finest zinc filings, minium, or even powdered glass, a shadow can be obtained. This method affords indeed very sharp shadows, so that thin wires and even wire gauze can be projected in shadow on the disk. Righi has gone still further, and by substituting a sensitive gelatino-bromide plate, has photographed the shadows produced during a five or ten minutes' discharge. In this experiment two figures showed themselves: one, the genuine electric shadow; the other, the genuine photographic shadow cast by the opaque object under the faint star of light emanating from the electrified point above.

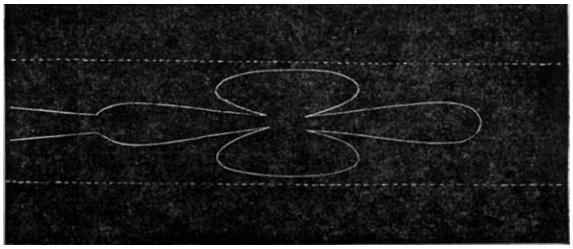

FIG. 4

If the object whose shadow is to be thus obtained is itself electrified, a curious effect is observed. If it be electrified with a charge of the same sign as that of the point above it, the shadow swells out. If electrified with a charge of opposite sign, the shadow becomes attenuated. Connecting the object to earth has the same effect as in the latter case. The presence of an electrified body on the right or left of the region in which the discharge is taking place has the effect of causing the shadow to be displaced. In fact the presence of such a body alters the equipotential surfaces, and therefore alters the lines of electric force in the field. If the discharge takes place through two points placed side by side at a short distance apart over two objects respectively beneath them, the two electric shadows are mutually repelled from the positions where their geometrical shadows lie. Similar observations of electrostatic influence were made two years ago by Messrs. Fine and Magie of Princetown, New Jersey.

Much as has been done of late years, especially by the late Mr. Spottiswoode in conjunction with Mr. J. F. Moulton, by Drs. De La Rue and Hugo Müller, by Crookes, by Goldstein, and others, to elucidate the phenomena of electric discharges, there probably still remains much to be discovered, and to be explained. The phenomena of electric shadows are amongst the matters best worthy of study in this rapidly progressing department of science. SILVANUS P. THOMPSON

NOTES

WE give this week a further instalment of notices of the strange coloured effects recently observed in the skies, and our readers in all parts of the world will render a service if they will communicate any similar facts they may have observed, giving, as far as possible, accurate dates. In an article in Saturday's *Times*, Mr. Norman Lockyer shows that the body of evidence already to hand connects them with the eruption of Krakatoa but, to place the matter beyond doubt, further information is required. The study of direction and of dates, and the facts touching the variation in the phenomena from August to December, all point in the same direction.

NO one will be surprised, though all must regret, that his state of health and advanced years have compelled Prof. Owen to resign his appointment as Superintendent of the Natural History Department of the British Museum. Prof. Owen's pre-eminent services to science, pure and applied, are too well known to require recapitulation in these columns, especially as very recently we referred to them in detail in connection with his portrait as one of our "Scientific Worthies." Advanced in years as he is, the venerable naturalist's interest in science seems as strong as ever; to each of the last two meetings of the Royal Society he contributed an important paper: we hope they will be by no means the last of such contributions.

WE learn with the greatest pleasure that Prof. Sylvester has been appointed to succeed the late Prof. Henry Smith in the Savilian Chair of Geometry at Oxford. No more worthy successor to the late Savilian Professor could have been found, and it is satisfactory to know that at last the services of one of our greatest living mathematicians have been permanently secured for his native country.

THE ceremony of distributing the prizes to the successful students of the Finsbury Technical College and the South London Technical Art School took place on Monday evening in the Hall of the Clothworkers' Company, Mincing Lane. The Lord Mayor presided, supported by the President of the Royal Society, the Sheriffs, Sir

F. Bramwell, Sir F. Abel, the newly-elected chairman of the Society of Arts, and a large number of gentlemen interested in promoting technical education, the hall being filled with students. The prizes were delivered by Prof. Huxley, who afterwards gave an address. After speaking of the progress in technical education which had been made since 1877, and speaking in high terms of the system pursued at the Finsbury Technical College, Prof. Huxley said that all his life he had been trying to persuade people that if they wanted to teach physical science it was no use to attempt to proceed by filling the minds of the students with general propositions which they did not understand, from which they were to deduce details which they comprehended still less. If they went to the Exhibition Road, South Kensington, they would see a very splendid pile of buildings which had already cost 75,000*l.*, and which he sincerely trusted would cost a very great deal more. That building was the mere bricks and stones of the Central Institute, and the business upon which Sir Frederick Bramwell, the Chairman of the Committee, he (Prof. Huxley), and his colleagues had lately been so largely occupied was making a soul for this body. It was an immensely difficult operation, as they were always in danger, like Frankenstein in the story, of making something which would eventually devour them instead of being useful to them. Their great anxiety had been to make it good and useful, so that the great scheme of technical education might be thoroughly carried into effect. He was perfectly sure that they had in the system of technological examination, and in such institutions as Finsbury College, the Kennington School, and the Central Institution, something which would most indubitably be the nucleus of a vast growth of similar organisations. He had not the smallest doubt that, before this generation had passed away, instead of 150 centres at which such examinations were conducted, they would be counted by hundreds, and instead of the two or three high-class places of technical instruction which had been enumerated they would be counted in different parts of this island by the score, and that they would have in the Central Institute the great uniting point for the whole of this network through which the information and the discipline which were needful for carrying the industries of the country into operation would be distributed into every locality in which such industries were carried on. He regarded it as even a more important function of such organisations that they would be places to which every young artisan of industry and ability could look to gratify his legitimate ambition. His study of history had led him to the conclusion that there never had been, and there never was likely to be, any great cause of widespread social discontent except hunger of some kind or other. There was physical hunger of the body, and there was intellectual hunger arising in the minds of capable and energetic men who were prevented by the accidents of life, or the organisation of society, from taking the places for which they were fitted. Everything which spreads a knowledge of technical processes among our industrial classes tended to fit them to fight better that great battle of competition in which they had hitherto maintained themselves victoriously in virtue of the inward natural powers and capacity of the race, but in which the struggle became more difficult, not only because on the continent of Europe training and discipline were supplementing whatever might be lacking of energy and capacity, but because on the other side of the Atlantic there was a people as numerous as ourselves, of the same stock, blood, race, and power, who would run us harder than any competitors had hitherto done. If we were to hold our own in this great world competition, it must be because the native force and intelligence were supplemented by careful training and discipline, such as were proposed to be given by the system of technical education.

At the meeting last week in connection with the memorial to the late Mr. Spottiswoode, a committee was formed for the purpose of procuring a portrait or bust for presentation to the Royal Society, and also to consider the question of establishing a further memorial of his connection with the Society. Prof. Huxley, Mr. W. De La Rue, Mr. Bowman, Dr. Evans, the Astronomer-Royal, and Mr. F. Galton, were appointed as members of the committee.

We have received from the publishers, Messrs. De la Rue and Co., a sample of their pocket-books, date cards, and pretty Christmas cards, which each year seem to become more and more attractive. The pocket-book, a *spécialité* which Messrs. De la Rue have brought to great perfection, is indeed a *multum in parvo*. Not only does it contain the usual almanac, but also much useful information. The mean time of high water in all parts of the world, the length of a degree of latitude and longitude, a table of magnetic elements, which, as inferred for next year, are declination 18° 12′ W., inclination 67° 32′, horizontal force 3·92, vertical force 9·50, total force 10·27, a table of specific gravities, the various tables of weights and measures together with the French measures, the dates of eclipses, and the mean time of the sun's southing, &c., all given with the usual exactness which has caused this pocket-book to be looked to by many scientific men as a help in their daily work. The date cards are in all shapes and sizes, for hanging on an office wall or to stand on the writing table in the study. The Christmas cards are now produced with such care in drawing and colour as to have become veritable works of art, and it is truly a difficult task to select from amongst the different series before us those which may be considered to carry off the prize. Mention must, however, be made of the beautiful etchings on satin and the coloured drawings of child and bird-life, the latter particularly showing both artistic and scientific knowledge, and it was a happy thought to produce these on such a material as satin, which gives a wonderful softness and finish to the pictures, and makes them suitable for adorning screens, panels, sachets, and the various dainty trifles which will be eagerly sought for this Christmas. The hunting series is drawn with great spirit, and many a child, both old and young, will be charmed with the novel idea of the introduction of the persistence of vision by building up a hunting scene by the hunters and hare on one side and the horses and dogs on the other of a rapidly spun card. Other cards too are arranged to introduce Wheatstone's principle of the wheel of life. The flower series, which is drawn with the same delicacy that we noticed in the colouring of the birds' plumage, is this year enriched by some Alpine favourites, which will carry many of us back to our summer haunts, and cause us to thank Messrs. De la Rue for enabling us to recall at this inclement season one of the many enjoyments of our yearly holiday.

The *Times* of Friday last contains an account of the results obtained in the *Dacca* and *International*, which were sent out to take soundings in the Atlantic for the purpose of laying a cable between Spain and the Canaries. Mr. Buchanan accompanied the expedition, and his observations on the corals, which seem to be creating a "coming Atlantis," are of much interest. The precise information obtained about some of the banks which stud this part of the Atlantic is a valuable addition to existing knowledge on the subject.

The naturalist Petit has returned to France from the Congo region, where he has spent several years, especially between the Gaboon and the Congo. He brings home large collections, especially in ornithology.

One necessary result of the scattered population of the United States of America has been the co-education of the sexes. Other countries have inquired as to the effect of the mixing together of boys and girls not only in schools but also in classes, and this has led the Bureau of Education to take the opinions of the school officers of 144 towns of less than 7000 inhabitants, and 196 larger cities, as to the good or evil result therefrom. There is an almost uniform reply in its favour. Only 19 out of the whole number separate the sexes, and only 12 out of these speak decidedly against it. The general morality and tone of society in America prevent its having any mischievous effect, while their innumerable small schools necessitate a large supply of female teachers who are the better qualified by their early competition and parallel education with boys. The Bureau, however, calls attention to the fact that both advantages may be absent in an older and more thickly populated country where concentration and division of labour is more practicable.

THE Report of the Manchester Public Free Libraries is a very satisfactory one, showing that since 1876–77, when the issues of books had been decreasing for several years, a steady revival has set in and their circulation has increased more rapidly than the population. Nothing also speaks so well for the successful work, present as well as prospective, of both central and district libraries as the new catalogues of first one and then another which have followed each other at average intervals of six months only.

ON November 22, at about 9 a.m., a remarkable phenomenon was observed at Alfta in the province of Helsingland. The weather was mild and calm, and the sky clear, when from the north the rays of an aurora began to develop, and soon bathed the northern heavens. Down by the eastern horizon a heavy dark cloud rested, from which a magnificent meteor suddenly darted forth. It traversed almost the entire heavens, spreading a deep lurid light over every object, before which even the aurora paled. The simultaneous observation of a starlight sky, a flaming aurora, and a splendid meteor in the depth of winter is described as very striking.

THE *Revue Positive*, which has been edited by the late M. Littré, and latterly by M. Wirouboff, has published its last number. The reason alleged is the want of interest now felt in France for merely theoretical questions, and the success obtained in a number of special directions by the principles of positive philosophy. It has lived fifteen years.

PART III. VOL. II. of the *Memorie della Società Geografica Italiana* is entirely occupied with the working out of the zoological collections made during the Italian Expedition to Equatorial Africa. Signor Vinciguerra treats on the freshwater fishes, M. A. de Bormans on the Orthoptera, M. C. Oberthür on the Lepidoptera, and M. Lethierry on the Hemiptera; in all cases there were new forms to describe, and the most interesting Lepidoptera are illustrated on a large folded plate. These memoirs appeared originally in the *Annali del Museo Civico di Storia Naturale di Genova*, but will be useful in their collected form.

EARTHQUAKES are reported (1) from Steinbruck (Styria), where a severe shock was felt on November 7 at 3 p.m., and a second one six minutes later, both in a vertical direction; (2) from Kaltenbach, near Müllheim, where a loud subterranean noise was heard, accompanied by a shock on November 11 at 9 p.m. The phenomenon was also observed in the surrounding villages, and was preceded in the daytime by a severe thunderstorm; (3) from the neighbourhood of Trawnik (Bosnia), where, on November 15 at 9.45 p.m., a violent undulatory earthquake was felt, accompanied by subterranean noise. The phenomenon lasted five seconds, and its direction was from north-west to south-east. An earthquake is also reported from Patra (Greece), where a violent shock occurred on November 14 at 3.40 a.m.

IN connection with the Quekett Microscopical Club, six demonstrations upon elementary subjects connected with microscopy will be given at University College, in Class Room No. 8, at 7.30, on the following evenings:—December 14, 1883, Cutting Sections of Hard Tissues, by T. Charters White, M.R.C.S.; January 11, 1884, Microscopical Drawing, by J. D. Hardy; February 8, the Sponge Skeleton as a means of recognising Genera and Species, by J. G. Waller; March 14, How to Work with the Microscope, by E. M. Nelson; May 9, Polarised Light, by Charles Stewart, F.L.S.; June 13, Staining Vegetable Tissues, by W. H. Gilburt.

ON the Zuiderzee interesting experiments were recently made with fog-horns of a novel construction. They are sounded by steam, and are worked after the fashion of Morse telegraphs with long and short sounds. Two ships were provided with the fog-horns; on each there were telegraphists working the horn, and the signals were distinctly heard and understood even if the distance between the ships was such that they lost sight of each other.

A GERMAN Meteorological Society was founded at Hamburg on November 18 last, when many eminent men of science were present. Dr. Neumayer was elected president; the object of the Society was defined as—"The cultivation of meteorology as a science and in its relations to practical life." The Society will support meteorological research and publish a meteorological serial. At the first meeting Dr. Hellmann spoke on twilight phenomena, Dr. van Bebber on barometrical minima with erratic movement, and Dr. Köppen on his method of testing the results of weather forecasts.

THE additions to the Zoological Society's Gardens during the past week include two Lesser White-nosed Monkeys (*Cercopithecus petaurista*) from West Africa, presented respectively by the Rev. W. C. Willoughby and Mr. S. E. Sims; twenty Barbary Turtle Doves (*Turtur risorius*) from India, presented by Mr. A. T. Hirsch, F.Z.S.; two Bearded Titmice (*Panurus biarmicus*), European, presented by Mr. H. D. Astley, F.Z.S.; a Water Rail (*Rallus aquaticus*), British, presented by Mr. E. G. B. Meade Waldo; an Indian Crocodile (*Crocodilus palustris*) from India, presented by Sir Joseph Fayrer, K.C.S.I., F.Z.S.; two Scaly-breasted Lorikeets (*Trichoglossus chlorolepidotus*), from New South Wales, a St. Thomas's Conure (*Conurus xantholæmus*) from St. Thomas, West Indies, four West African Love Birds (*Agapornis pullaria*) from West Africa, two Undulated Grass Parrakeets (*Melopsittacus undulatus*), a Cockateel (*Colopsitta novæ-hollandiæ*) from Australia, two Indian Crocodiles (*Crocodilus palustris*) from India, deposited; a Hairy Porcupine (*Sphingurus villosus*) from Brazil, on approval; two Cirl Buntings (*Emberiza cirlus*), British, purchased.

OUR ASTRONOMICAL COLUMN

ENCKE'S COMET.—On October 16 M. Otto Struve presented to the Imperial Academy of Sciences of St. Petersburg a new memoir on the motion of Encke's comet, by Dr. Backlund, of the Observatory at Pulkowa, who has continued the researches commenced by the late Dr. von Asten. Shortly before the decease of the latter, in August, 1878, he had completed a memoir upon this comet, in which it was proved that the appearances between 1819 and 1858 might be comprised, so to say, under a single formula, adopting one value for the effect of a resisting medium; or an acceleration of 0″·104 in the mean motion in each revolution. Nevertheless the observations at the different returns were not represented with such a degree of precision as to exclude a probable error of 9″·0 for each co-ordinate of a normal position, and for certain appearances the agreement with the formula was so little satisfactory that a suspicion arose of the existence, besides gravitation and a resisting medium, of other agents which had affected the motion of the comet. The suspicion was further increased when it was found by Asten that